

## Antimicrobial Activity of Some Selected Medicinal Plants in Some Northern Parts of Bauchi State, Nigeria

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**Abstract:** Antimicrobial activity of some medicinal plants traditionally used by local communities in the treatment of tuberculosis and other respiratory diseases was carried out. The antimicrobial activity of the plants extracts against some microbial pathogens was investigated as preliminary study to screen the plants for their anti-tuberculosis activity. The antimicrobial test was done using agar disc diffusion method and the minimum inhibitory concentration (MIC) was also determined by Micro broth dilution method. The result indicated that the extracts had varied activity against the tested organisms. The extracts also showed dose dependent antimicrobial activity but significantly lower than the standard antibiotic drugs (ciprofloxacin and Ketoconazole). The extract of *E. hirta* has no activity against *E. coli* at the tested concentrations but shown the zone of inhibition range from 10- 16mm for other tested organisms. *E. hirta* has MIC of 15µg/ml against *K. pneumonia* and *C.albicans* and 30mg/ml for *B.subtilis*, *S. typhi* and *S aureus*. The extract of *C. mucronata* has shown zone of inhibition range from 12- 16mm but it has no activity against *B. subtilis* at the tested concentrations. It has MIC of 15µg/ml against *C.albicans*, *B. subtilis*, *K.pneumonia*, *E.coli* and 30µg/ml against *S. aureus*. The stem bark extract of *X. americana* has shown the zone of inhibition range of 10-16mm and active against all the tested organisms. It has MIC of 15µg/ml against *S. aureus* and *K. pneumonia*. The leaf extract of *W. indica* has shown zone of inhibition ranging from 11- 16mm. It was active against all the tested pathogens and exhibited MIC of 15µg/ml against *S. aureus* and *C. albicans*. The leaf extract of *P. reticulatum* has shown the zone of inhibition ranges from 9-15mm against the tested organisms. It exhibited MIC of 15µg/ml against *S. typhi*. The aerial parts extract of *S. hermonthica* has shown zone of inhibition ranges from 12- 16mm. The extract has shown the zone of inhibition (12, 14 and 16mm) against *C. albicans* at the concentration of 15, 30 and 60 µg/ml respectively. But the extract has no activity against *S. typhi* at the tested concentrations. The extract has MIC of 15µg/ml against *B. subtilis* and *C. albicans*. The extract of *T. indica* has shown the zone of inhibition ranges from 10-15mm. But the extract has no activity against *C. albicans* at all tested concentrations. It has MIC of 15µg/ml against *K. pneumonia* and *E.coli*. The extract of *E. senegalensis* has shown the zone of inhibition ranging from 11- 14mm. However the extract has no activity at the lowest concentration of 15µg/ml against all the organisms except *S. aureus*. The extract has MIC of 15µg/ml against *S. aureus* and 30µg/ml against all other organisms tested. The leaf extract of *B. paradoxum* has shown a zone of inhibition of 16mm against *E. coli* and zone of inhibition ranges from 11- 16mm. The MIC of the extract against *E. coli*, *S. typhi* and *B. subtilis* is 15µg/ml and 30µg/ml for *C. albicans*. However the extract has no activity at all tested concentrations against *S. aureus* and *k. pneumonia*. The extracts that exhibited zones of inhibition greater than 10mm were considered active and therefore recommended for further screening to isolate and characterize the bioactive chemical constituents.

**Keywords:** Methanol extracts, antimicrobial activity, MIC, medicinal plants.

### 1. INTRODUCTION

Despite the influence of modern drugs the use of medicinal plants has remained a very important aspect of health care delivery system especially in rural areas. It was reported that 80% of world's population relies on traditional medicines as primary source of their medication (Newman, 2006). The plant based preparations were central to traditional practice of health care system where herbs and different parts of medicinal plants are employed. Medicinal plants have some medicinal values based on folkloric usage and information. It was reported that plants are natural reservoir of therapeutic agents use by the local communities in the treatment of many diseases (Akinniyi and Tella, 1991). The clinical success of plant-based drugs has rekindled interest in research into medicinal plants as potential sources of new drugs. In some countries like China, India and Vietnam the research in to

medicinal plants has been fully developed and plant-based remedies have been incorporated as alternative or complementary medicines to supplement the modern drugs. However, in Nigeria like in most African countries the research into medicinal plants has not been given a desire attention as such the therapeutic potentials of these natural endowments were under-utilized (Ogundaini, 2005).

In fact, the phyto-chemical agents in medicinal plants were shown to be responsible for the observed therapeutic activity against the diseases caused by pathogenic infections. There were several plant extractives that demonstrated significant inhibitory activity against microscopic pathogens like bacteria, fungi and viruses (Malcolm and Sofowora, 1969; Kone *et al.*, 2004; Sanogo, 2005; Hamza and Mbwabo, 2006; Kubmarawa *et al.*, 2007; Tanaka *et al.*, 2010). The screenings of medicinal plants for antimicrobial activity have shown that higher plants represent a potential source of novel antibiotic chemotypes (Copp, 2003; Katerere *et al.*, 2003; Ogundaini, 2005; Kubmarawa *et al.*, 2007). The plants were screened for the presence of bioactive chemical constituents and it was found that they contained phytochemical constituents like alkaloids, flavonoids, steroids, terpenoids, glycosides, anthraquinones, saponins and tannins (Aska and Kubmarawa, 2016).

In the present study, we are reporting the antimicrobial activity of some selected medicinal plants used in the treatment of tuberculosis and related respiratory diseases in Northern parts of Bauchi state, Nigeria.

## **2. MATERIALS AND METHODS**

### **2.1. Plant Material**

The different parts of the selected medicinal plants were collected from Three (3) Local Government Areas in the Northern parts of Bauchi State, Nigeria using standard method. The freshly collected plant samples were conveyed in clean polythene bags to Biology Department, Abubakar Tafawa Balewa University, Bauchi for identification by a taxonomist who identified and classified the plants specimens and voucher specimens was prepared and deposited in the Departmental Herbarium (Abdalfatah, *et al.*, 2013; Zailani, *et al.*, 2010; Mann, *et al.*, 2008a; Kubmarawa, *et al.*, 2007).

### **2.2. Drying and Pulverising**

The samples of different parts of the plants were dried under shade inside a room. The fresh samples were spread out and turned regularly to dry them properly. The well dried samples were pulverized to fine powder using a wooden mortar and pestle. The powder of each sample was weighed using analytical balance and kept at room temperature until use (Ibrahim, *et al.*, 2012).

### **2.3. Extraction**

The plants samples were subjected to exhaustive extraction using soxhlet extractor. One hundred grams (100g) of each sample in 70% Methanol was used in the extraction process which lasted for 12hrs. The crude extract of each sample was filtered and concentrated in an oven at 40°C. The dried methanol extracts were then packed in glass bottles with proper labeling for future use (Trease and Evans, 1989).

### **2.4. Extracts Preparation**

The different concentrations (15, 30 and 60µg/ml) were prepared from 5g each of the crude methanol extracts of the plant samples. These concentrations were used to test the antimicrobial activity of the crude extracts.

### **2.5. Microorganisms Tested**

Micro-organisms tested are *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumonia*, *Salmonella typhi*, *Bacillus subtilis* and *Candida albicans*. The clinical isolates were obtained from Mallam Aminu Kano Teaching Hospital Kano, Nigeria. The micro-organisms were grown and cultured in microbiology Laboratory of Bayero University Kano (BUK) Nigeria.

### **2.6. Antimicrobial Susceptibility Test**

The Agar disc diffusion method was used to evaluate the antimicrobial activity of the plants extracts (Mangoma, *et al.*, 2010, Atikya *et al.*, 2014). The bacteria were cultured in nutrient agar medium at 37°C for 24hours. The fungal was cultured on dextrose agar medium inoculated at 25°C for 7 days. Ciprofloxacin and ketoconazole were used as standard reference antibiotic drugs for bacterial and fungal respectively. The agar discs were impregnated with the different concentrations (60, 30 and 15 µg/ml) of the plants extracts. The inoculated medium was poured into sterile Petri dishes and

## Antimicrobial Activity of Some Selected Medicinal Plants in Some Northern Parts of Bauchi State, Nigeria

incubated at 25°C for 5 days. Ciprofloxacin (30µg/ml) and ketoconazole (30µg/ml) was impregnated into the disc as positive control for the bacteria and *Candida albicans* respectively. The disc impregnated with Dimethylsulphoxide(DMSO)(4%) and methanol(95% JHD) were used as negative control. All the Petri dishes were incubated at 37°C for 24 hours, after incubation the discs were observed for growth inhibitions against the tested microorganisms by the tested extracts. The diameters of inhibition were measured and recorded in Millimeters (mm).

### 2.7. MIC Determination

The minimum inhibitory concentration (MIC) was determined by Micro broth dilution method (Okwute, *et al* 2017). Prepared Muller Hinton broth was dispersed into test tubes and sterilized with autoclave at 121°C for 15mins then the broth was allowed to cool. Two fold serial dilutions were used to obtain concentrations of 60µ/ml, 30µ/ml, 15µ/ml, 7.5µg/ml and 3.75µg/ml of the crude extracts. 60µg/ml was initially made by dissolving 0.06mg of the crude extract in 10ml of DMSO to obtain 60µg/ml from which subsequent concentrations were prepared using two fold dilutions. Methanol (70%) was used as a negative control. The microorganisms sensitive to the tested extracts were inoculated and incubated for 24 hrs at 37°C and the lowest concentration of the extracts that showed no visible growth was recorded as the minimum inhibitory concentration (MIC).

### 3. RESULTS OBTAINED

**Table1a.** Antimicrobial sensitivity test of crude methanol extracts of the samples

| Test organisms used | Conc(µg/ml)<br><i>P. reticulatum</i><br>(mm) |    |    | Conc(µg/ml)<br><i>S. hermonthica</i><br>(mm) |    |    | Conc(µg/ml)<br><i>T. indica</i><br>(mm) |    |    | Conc(µg/ml)<br><i>E. Senegalensis</i><br>(mm) |    |    | Conc(µg/ml)<br><i>V. paradoxa</i><br>(mm) |    |    |
|---------------------|--|----|----|--|----|----|---|----|----|---|----|----|---|----|----|
|                     | 60   | 30 | 15 | 60   | 30 | 15 | 60                                      | 30 | 15 | 60  | 30 | 15 | 60  | 30 | 15 |
| <i>S. Aureus</i>    | 13   | 10 | NA | 14   | 12 | NA | 13                                      | 9  | NA | 12  | 10 | 9  | NA  | NA | NA |
| <i>E. Coli</i>      | 10   | NA | NA | 12   | 9  | NA | 15                                      | 12 | 10 | 13  | 12 | NA | 16  | 14 | 11 |
| <i>B. Subtilis</i>  | 13   | 9  | NA | 15   | 13 | 11 | 11                                      | 9  | NA | 14  | 11 | NA | 14  | 12 | 10 |
| <i>K.Pneumonia</i>  | 14   | 11 | NA | 11   | 9  | NA | 14                                      | 11 | 9  | 12  | 10 | NA | NA  | NA | NA |
| <i>S. Typhi</i>     | 15   | 12 | 9  | NA   | NA | NA | 12                                      | 11 | NA | 13  | 10 | NA | 15  | 12 | 9  |
| <i>C. Albicans</i>  | 13   | 11 | NA | 16   | 14 | 12 | NA                                      | NA | NA | 10  | 9  | NA | 11  | 10 | NA |

\*NA= NO ACTIVITY      \*NT= NOT TESTED

**Table1b.** Result of Antimicrobial sensitivity test of crude methanol extracts of the samples

| Test organisms used | CONC(µg/ml)<br><i>E. hirta</i><br>(mm) |    |    | CONC(µg/ml)<br><i>C. mucronata.</i><br>(mm) |    |    | CONC(µg/ml)<br><i>X. americana</i><br>(mm) |    |    | CONC(µg/l)<br><i>W. indica</i><br>(mm) |    |    | Ciprofl<br>oxacin<br>(30 /ml)<br>(mm) | Ketoco<br>nazole<br>(30 /ml)<br>(mm) |
|---------------------|--|----|----|---|----|----|--|----|----|--|----|----|---------------------------------------|--------------------------------------|
|                     | 60                                     | 30 | 15 | 60  | 30 | 15 | 60   | 30 | 15 | 60                                     | 3  | 15 |                                       |                                      |
| <i>S. Aureus</i>    | 12                                     | 11 | NA | 13  | 10 | NA | 16   | 14 | 10 | 16                                     | 12 | 11 | 33                                    | NT                                   |
| <i>E. Coli</i>      | NA                                     | NA | NA | 16  | 14 | 12 | 14   | 10 | NA | 14                                     | 11 | NA | 28                                    | NT                                   |
| <i>B. Subtilis</i>  | 14                                     | 10 | NA | NA  | NA | NA | 12   | 9  | NA | 12                                     | 9  | NA | 31                                    | NT                                   |
| <i>K. Pneumonia</i> | 16                                     | 13 | 10 | 12  | 10 | 9  | 15   | 12 | 9  | 11                                     | 10 | NA | 25                                    | NT                                   |
| <i>S. Typhi</i>     | 11                                     | 9  | NA | NA  | 10 | 8  | 13   | 9  | NA | 10                                     | 9  | NA | 22                                    | NT                                   |
| <i>C. Albicans</i>  | 12                                     | 10 | 9  | 14  | 10 | 9  | 11   | NA | NA | 11                                     | 10 | 9  | NT                                    | 28                                   |

\*NA= NO ACTIVITY      NT= NOT TESTED

**Table2.** Result of minimum inhibitory concentration (MIC) of the crude extracts

| Plant                         | Sample used         | MIC (µg/ml) |    |    |    |    |    |
|-------------------------------|---------------------|-------------|----|----|----|----|----|
|                               |                     | Sa          | St | Kp | Ec | Bs | Ca |
| <i>Waltheria indica</i>       | Leaf extract        | 15          | 30 | 30 | 30 | 30 | 15 |
| <i>Ximenia Americana</i>      | Stem bark extract   | 15          | 30 | 15 | 30 | 30 | 60 |
| <i>Pilostigma reticulatum</i> | Leaf extract        | 30          | 15 | 30 | 60 | 30 | 30 |
| <i>Striga hermonthica</i>     | Aerial part extract | 30          | -  | 30 | 30 | 15 | 15 |
| <i>Vitellaria paradoxa</i>    | Leaf extract        | -           | 15 | -  | 15 | 15 | 30 |
| <i>Cissampelos ucronata</i>   | Root extract        | 30          | 15 | 15 | 15 | -  | 15 |
| <i>Euphorbia hirta</i>        | Whole plant extract | 30          | 30 | 15 | -  | 30 | 15 |
| <i>Tamarindus indica</i>      | Root-bark extract   | 30          | 30 | 15 | 15 | 30 | -  |
| <i>Erythrina senegalensis</i> | Stem-bark extract   | 15          | 30 | 30 | 30 | 30 | 30 |

**KEY:**Sa=*Staphylococcus aureus*, St = *Salmonella typhi*, Ec = *Escherichia coli*, Kp = *Klebsiella pneumoniae*,

Bs = *Bacillus subtilis*, Ca = *Candida albicans*.

### 3.1. Discussion

Antimicrobial activity of the plants samples were tested against fungal and some bacterial pathogens using agar disc diffusion method (Mangoma, *et al.*, 2010, Atikya, *et al.*, 2014). The result of the antimicrobial sensitivity test was presented in table 1a & b. The minimum inhibitory concentration (MIC) was presented in table 2. The Antimicrobial sensitivity test of crude methanol extracts of the samples indicated that the extracts exhibited varied antimicrobial activity against the tested organisms. The zones of inhibition (mm) ranged from 9-16. The extracts exhibited dose dependent antimicrobial sensitivity test however they were significantly lower than the standard antibiotic drugs ciprofloxacin and Ketoconazole. Ciprofloxacin shown inhibition against the tested organisms with zones range of 22-33mm at the concentration of 30 µg/ml. Standard antifungal(Ketoconazole) shown inhibition against *C. albicans* with inhibition zone of 28mm at the concentration of 30µg/ml.

The whole plant extract of *E. hirta* has shown a greater zone of inhibition (16mm) against *K. Pneumonia*, the zone of inhibition ranges from 10- 16mm. The extract has shown the zone of inhibition against *C. albicans* that ranges from 9-12mm at the concentration of 15, 30 and 60 µg /ml respectively. *S. aureus* was inhibited with zones of 11-12mm for 30 and 60 µg /ml. respectively. But the extract has no activity against *S. aureus* at the lowest concentration (15 µg /ml) of test extract. *E. hirta* has zone of inhibition of 10-14mm against *B. subtilis* at the concentration 30 and 60 µg /ml. respectively. But the extract has no activity against *B. subtilis* at the lowest concentration (15 µg /ml) of test extract. Srilakshmi, *et al.*, (2012) has supported this finding because they reported that the ethanol extracts of *E. hirta* inhibited the growth of *S. aureus*, *S. typhi* and *E. coli* at 25µg/ml with zones of inhibition of 13.6, 12.8 and 7.2mm respectively. *S. typhi* was inhibited with zones of 9-11mm for 30 and 60 µg /ml respectively. But the extract has no activity against *S. typhi* at the lowest concentration (15 µg /ml) of test extract. *E. hirta* has no activity against *E. coli* at the tested concentrations. However, this disagreed with the report of Srilakshmi *et al.*, (2012) who reported that the ethanol extracts of *E. hirta* gave zone of inhibition (7.2mm) against *E. coli* at 25µg/ml. It might be attributed to differences in environmental factors of location of the sample collection. *C. mucronata* has shown a greater zone of inhibition (16mm) against *E. coli*, the zone of inhibition ranges from 12-16mm. The extract has shown the zone of inhibition against *K. pneumoniae* that ranges from 9-12mm at the concentration of 15, 30 and 60 µg/ml. respectively. *S. Aureus* was inhibited with zones of 10-13mm for 30 and 60 µg /ml. respectively. But the extract has no activity against *S. aureus* at the lowest concentration (15 µg /ml) of test extract. *C. mucronata* has zone of inhibition of 9-14mm against *C. albicans* at the concentration of 15, 30 and 60 µg /ml respectively. But the extract has no activity against *B. subtilis* at the lowest concentration (15 µg /ml) of test extract. *S. typhi* was inhibited with zones of 9-11mm for 30 and 60 µg /ml respectively. But the extract has no activity against *S. typhi* at the lowest concentration (15 µg /ml) of test extract. *C. mucronata* has no activity against *B. subtilis* at the tested concentrations.

The stem bark extract of *X. americana* has shown a greater zone of inhibition (16mm) against *S. aureus*, the zone of inhibition ranges from 10- 16mm. The extract has shown the zone of inhibition against *K. pneumoniae* that ranges from 9-15mm at the concentration of 15, 30 and 60 µg /ml. respectively. But the extract has no activity against *E. coli* and *B. subtilis* at the lowest concentration (15 µg /ml) of the test extract. However the extract shown zone of inhibition that ranges from 10-14mm and 9-12mm of *E. coli* and *B. subtilis* respectively. This finding agreed with study of Maikai, *et al* (2009) that reported that both butanol and methanol stem bark extracts of *X. Americana* showed activity against *E coli*, *S. aureus* and *B. subtilis*. The stem bark extract of *X. americana* has zone of inhibition of 11mm against *C. albicans* at the concentration of 60 µg /ml only. But the extract has no activity against *C. albicans* at the concentration of 30 µg/ml and 15 µg /ml of test extract. This is supported by a similar study by Maikai, *et al.*, (2009) who reported that the methanol and water extracts of stem of *X. americana* exhibited activity against candida albicans. *S. typhi* was inhibited with zones of 9 and 13mm for 30 and 60 µg /ml respectively. But the extract has no activity against *S. typhi* at the lowest concentration (15 µg /ml) of test extract.

The leaf extract of *W. indica* has shown a greater zone of inhibition (16mm) against *S. aureus* at the highest concentration and zone of inhibition ranges from 11- 16mm for all tested pathogens. The extract has shown the zone of inhibition (9, 10 and 11mm) against *C. albicans* at the concentration of 15, 30 and 60 µg /ml respectively. *E. coli*, *B. subtilis*, *K. pneumonia* and *S. typhi* were only inhibited at higher concentrations of 30 and 60 µg /ml. But the extract has no activity against *E. coli*, *K. pneumonia*, *S. typhi* and *B. subtilis* at the lowest concentration of 15µg/ml. In a similar study conducted the ethanol extract of leaves of *W. indica* inhibited the growth of *E. coli*, *S. typhi* and *S. aureus* with inhibition zones of 10±1, 12±1 and 13±1mm respectively (Olajuyigbe *et al.*, 2011).

The leaf extract of *P. reticulatum* has shown a greater zone of inhibition (16mm) against *S. typhi*, the zone of inhibition ranges from 9-15mm. The extract has shown the zone of inhibition (11 and 13mm) against *C. albicans* at the concentration of 30 and 60 µg /ml respectively. The extract shown inhibition at higher concentration against *E. coli* with zone of 10mm *B. subtilis* was inhibited at concentration of 30 and 60 µg /ml with zone of 9 and 13mm respectively. *K. pneumonia* was inhibited at concentration of 30 and 60 µg /ml with zone of 11and 14mm respectively. *E. coli* was only inhibited at higher concentrations of 60 µg /ml with zone of 10mm. But the extract has no activity against *E. coli*, *K. pneumonia*, *S. aureus*, *C. albicans* and *B. subtilis* at the lowest concentration of 15µg/ml. In a similar study it was reported that the ethanolic leaf extract of *P. reticulatum* showed broad antimicrobial activity against *S. aureus*, *E. coli* and *S. typhi* (Olusola, *et al.*, 2011).

The aerial parts extract of *S. hermonthica* has shown a greater zone of inhibition (16mm) against *C. albicans* the zone of inhibition ranges from 12- 16mm. The extract has shown the zone of inhibition (12, 14 and 16mm) against *C. albicans* at the concentration of 30 and 60 µg /ml respectively. This result disagreed with the findings of Elshiek and Mona, (2015) in which they reported that the ethanol extract of the whole plant was not active against *C. albicans*. This might be attributed to differences in environmental conditions. The extract also shown inhibition against *B. subtilis* at all tested concentrations with the inhibition zones of 11, 13 and 15mm respectively. *K. pneumonia* was inhibited at concentration of 30 and 60 µg /ml with zones of 9 and 11mm respectively. *E. coli* was also inhibited at concentrations of 30 and 60 µg /ml with zones of 9 and 12mm respectively. *S. aureus* was also inhibited at concentrations of 30 and 60 µg /ml with zones of 12 and 14mm respectively. But the extract has no activity against *S. typhi* at the tested concentrations. In a similar study carried out on the extracts of *S. hermonthica* against *Staphylococcus aureus*, *Bacillus subtilis*, *Escherichia coli*, and *Candida albicans* revealed that ethanol extract of the whole plant showed moderate activity against the tested bacteria but showed no activity against *Candida albicans* (Elshiek and Mona, 2015).

*T. indica* has shown a greater zone of inhibition (15mm) against *E. coli*, the zone of inhibition ranges from 10-15mm. The extract has shown the zones of inhibition (10, 12 and 15mm) against *E. coli* at the concentration of 15, 30 and 60 µg /ml respectively. The extract also shown inhibition at against *K. pneumonia* at all tested concentrations with the inhibition zone of 9, 11 and 14mm. *B. subtilis* was inhibited at concentration of 30 and 60 µg /ml with zone of 9 and 11mm respectively. *S. typhi* was also inhibited at concentrations of 30 and 60 µg /ml with zones of 9 and 12mm respectively. *S. aureus* was also inhibited at concentrations of 30 and 60 µg /ml with zones of 9 and 13mm respectively. But the extract has no activity against *C. albicans* at the tested concentrations. This finding agreed with the results of Kapur and John (2014) who reported the antimicrobial activity of ethanolic bark extracts of *Tamarindus indica* against growth inhibition of *S. aureus*, *K. pneumonia* and *E. coli* with inhibition zones of 16, 13 and 12mm respectively.

*E. senegalensis* has shown a greater zone of inhibition (14mm) against *B. Subtilis*, the zone of inhibition ranges from 11- 14mm. The extract has shown the zones of inhibition (12 and 14mm) against *B. subtilis* at the concentration of 30 and 60 µg /ml respectively. The extract also shown inhibition at against *S. aureus* at all tested concentrations with the inhibition zones of 9, 10 and 12mm. *k. pneumonia* was inhibited at concentration of 30 and 60 µg /ml with zone of 10and 12mm respectively. *S. typhi* was also inhibited at concentrations of 30 and 60 µg /ml with zones of 10 and 13mm respectively. *E. coli* was also inhibited at concentrations of 30 and 60 µg /ml with zones of 12 and 13mm respectively. *C. albicans* was also inhibited at concentrations of 30 and 60 µg /ml with zones of 9 and 10mm respectively. However the extract has no activity at the lowest tested concentration (15 µg /ml) against all the organisms except *S. aureus*. The results agreed with a similar

research on the antimicrobial activity of methanol, chloroform and aqueous stem bark extracts of *Erythrina senegalensis* using the filter paper disc diffusion method in which the extracts demonstrated antimicrobial activity against *Staphylococcus aureus*, *Escherichia coli*, *Salmonella typhi*, and *Candida albicans* (Doughari, 2010).

The leaf extract of *B. paradoxum* has shown a greater zone of inhibition (16mm) against *E. coli* the zone of inhibition ranges from 11- 16mm. The MIC of the extract against *E. coli*, *S. typhi* and *B. subtilis* is 15µg/ml and 30µg/ml for *C. albicans*. However the extract has no activity at all tested concentrations against *S. aureus* and *k. pneumonia*. The extract has shown the zones of inhibition (11, 14 and 16mm) against *E. coli* at the concentration of 15, 30 and 60 µg /ml respectively. The extract also shown inhibition at against *S. typhi* at all tested concentrations with the inhibition zone of 9, 12 and 15mm. *B. subtilis* was inhibited at concentration of 15, 30 and 60 µg /ml with zone of 10, 12and 14mm respectively. *S. typhi* was also inhibited at concentrations of 30 and 60 µg/ml with zones of 10 and 13mm respectively. *C. albicans* was also inhibited at concentrations of 30 and 60 µg /ml with zones of 10 and 11mm respectively. This result agreed with the findings of Kubmarawa *et al.*, (2007) who reported the antimicrobial activity of stem bark of *B. paradoxum* on the similar pathogens but the stem bark extract was active against *S. aureus* while in this work the leaf extract has no activity against *S. aureus*. This could be due to different parts of the plant used in the study, here leaves were used not the stem bark of the plant. Olajuyigbe, *et al* (2011) reported that zones of inhibition  $\geq 10$ mm were considered as good antimicrobial activity for the crude plant extracts. Thus, several extracts used in the study have exhibited zones of inhibition greater than 10mm and they are recommended for further screening to isolate and characterize the bioactive chemical constituents.

#### 4. CONCLUSION

The chemical constituents tested in the plants were the major therapeutic agents found in medicinal plants. Therapeutic activity against most diseases caused by pathogenic infections could be attributed to the present of these bioactive agents. The extracts have demonstrated significant inhibitory activity against the tested organisms even though some extracts are inactive. Therefore, the active plants extracts can act as potential source of compounds or “lead-compounds” for development of antimicrobial agents that could be useful in chemotherapy.

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